

The process is environmentally friendly, as it adds nothing to the air or drainage system.

The germicidal lamps do the job continuously without shutting down the system or vacating the building.

A complete installation of germicidal lamps can cost less than any other method purported to achieve the same results.

Although exemplary embodiments of the present invention have been shown and described, it will be apparent to those having ordinary skill in the art that a number of changes, modifications, or alterations to the invention as described herein may be made, none of which depart from the spirit of the present invention. All such changes, modifications and alterations should therefore be seen as within the scope of the present invention.

It is claimed:

1. A germicidal lamp for harsh environments adapted to be mounted on a wall, the wall having an insertion opening, the germicidal lamp comprising:

a low pressure germicidal tube which when energized emits UVC without substantial ozone and can withstand skin-effect cooling, the tube including an envelope and a stem, and

a fixture comprising a cover, a base and a tube holder, wherein

the base has an upper surface and a lower surface, the lower surface of the base seals against the wall to thereby prevent splashing water, hose-directed water, ice formations, wind, dirt, rain and environmental corrosion to pass there through,

the cover is at least partially detachable from the base so that the cover can be moved from a first position wherein the cover covers the upper surface to a second position wherein the cover is at least partially separated from the base to at least partially expose the upper surface of the base,

the cover and the upper surface of the base define an interior space within the fixture,

the cover seals tightly to the base to thereby prevent splashing water, hose-directed water, ice formations, wind, rain and environmental corrosion from entering the interior space of the fixture,

the base includes an opening through which the envelope of the tube is passed for installation of the tube in the fixture and removal of the tube from the fixture,

installation of the tube causes a flange on the tube stem to sealingly engage the base which seals the opening in the base of the fixture from air flow into the fixture,

the tube-holder, including an engaging surface adapted to engage and secure the stem of the tube, after the envelope has been inserted through the opening in the base of the fixture,

the cover and the base include exterior surfaces which are resistant to splashing water, hose-directed water, ice formations, wind, rain and environmental corrosion.

2. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 1 wherein the tube comprises an elongate hollow cylinder.

3. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 1 wherein the tube is adapted such that UVC output from the tube peaks when an air flow of between 200 cfm and 600 cfm at between 30° F. and 65° F. is passed across the tube.

4. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 3 wherein the tube is adapted

such that UVC output from the tube peaks when an air flow of 400 cfm at 55° F. is passed across the tube.

5. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 1 wherein the tube emits UVC of at least 10 $\mu\text{W}/\text{cm}^2$ per inch arc length at one meter when an airflow of between 100 and 800 cfm is passed across the tube.

6. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 1 wherein the tube emits UVC of at least 10 $\mu\text{W}/\text{cm}^2$ per inch arc length at one meter when an air flow of between 0° F. and 70° F. is passed across the tube.

7. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 1 having a weight of less than two lbs.

8. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 1 wherein the cover and the base of the fixture are separable.

9. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 1 wherein the cover and the base of the fixture have a clamshell design.

10. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 1 wherein the base of the fixture includes the tube-holder.

11. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 10 wherein the tube-holder comprises a spring clamp attached to the upper surface of the base of the fixture around the opening in the base, the spring clamp comprising a spring, a mount and two stops, the spring comprising wire in a substantially flat U shape, the stem of the spring's U being fixed by the mount to the upper surface of the base adjacent the opening such that the arms of the U are disposed on opposite sides of the opening, the mount allowing the spring to rotate such that the spring can be pivoted about the mount between a position substantially

30 parallel to the upper surface to a position substantially perpendicular to the upper surface, the stops holding the spring in compression and parallel to the upper surface, wherein the spring clamp wraps at least partially around the stem of the tube and presses the stem against the upper surface of the base of the fixture and thereby holds the tube in place and the tube in the fixture.

12. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 1 wherein the tube-holder is attached to the cover of the fixture, wherein the tube-holder is positioned in the cover such that, when the cover is closed onto the base of the fixture, the tube-holder also engages the stem of the tube and holds the tube firmly in place.

13. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 1 wherein the tube-holder includes an electrical connector which engages at least one electrode in the stem of the tube when the tube-holder engages the stem.

14. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 1, wherein installation of the tube causes the a flange on tube stem to sealingly engage the base, forming a seal, the seal is adapted to be seated around the opening in the base to thereby prevent splashing water, hose-directed water, ice formations, wind, dirt, rain and environmental corrosion to pass there through.

15. The germicidal lamp for harsh environments adapted to be mounted to a wall of claim 1 wherein the lower surface of the base seals against a wall, creating a seal between the fixture and the wall that can withstand air pressure of at least

60 15 inches of water gage.

16. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 1, the cover and the base

of the fixture defining an interior space, the fixture further comprising a power supply adapted to convert an input power source into a form appropriate for the tube.

17. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 1 further including an electrical connector disposed within the fixture adapted to electrically engage the stem of the tube, the germicidal lamp further including plural electrical leads attached to the electrical connector and extending outside of the fixture, the leads including piggyback connectors adapted to be connected to an air conditioner's power or fan controller, whereby other connectors on the controller can be removed from the controller and attached to the piggyback connector, and the piggyback can then be attached to the controller in place of the other connector.

18. The germicidal lamp for harsh environments adapted to be mounted to a wall of claim 1, wherein installation of the tube causes a flange of the stem to sealingly engage the base and form a seal between the tube and the fixture that can withstand air pressure of at least 30 inches of water gage.

19. The germicidal lamp for harsh environments adapted to be mounted to a wall of claim 1, wherein the cover seals tightly to the base to form a seal between the cover and the base that can withstand air pressure of at least 20 inches of water gage.

20. An air handling system comprising the germicidal lamp of claim 1.

21. An HVAC system comprising the germicidal lamp of claim 1.

22. A germicidal lamp for harsh environments comprising:

a single-walled tube having a stemmed end with a flange, and a free end and comprising

an envelope disposed between the ends having a first cross-sectional shape,

a rigid stem secured to the envelope at the stemmed end, the stem including at least one electrode; and

a fixture comprising:

a base having an upper surface and a lower surface, the base including an opening through which the envelope of the tube is passed for installation of the tube in the fixture and removal of the tube from the fixture, but through which the stem will not fully pass, the flange on the stemmed end of the tube sealingly engaging the base when the tube is installed, the lower surface of the base sealing against a wall to thereby prevent splashing water, hose-directed water, ice formations, wind, rain and environmental corrosion to pass there through, the base including an exterior surface which is resistant to splashing water, hose-directed water, ice formations, wind, rain and environmental corrosion; a socket disposed inside of the fixture and electrically coupled to at least one electrode;

a cover which is at least partially detachable from the base so that the cover can be moved from a first position wherein the cover covers the upper surface and the cover can be partially moved away from the base to at least partially expose the upper surface of the base, the cover sealing tightly to the base to thereby prevent splashing water, hose-directed water, ice formations, wind, rain and environmental

corrosion from entering the interior space of the fixture, the cover including an exterior surfaces which are resistant to splashing water, hose-directed water, ice formations, wind, rain and environmental corrosion;

a tube holder including an engaging surface adapted to engage and secure the stem of the tube.

23. The germicidal lamp for harsh environments of claim 22, the tube-holder comprising a spring clamp coupled to the primary wall around the opening, the spring clamp comprising a spring, a mount and two stops, the spring comprising wire in a substantially flat U shape, the stem of the spring's U being fixed by the mount to the first wall adjacent the through-hole such that the arms of the U are disposed on opposite sides of the through-hole, the mount allowing the spring to rotate such that the spring can be pivoted about the mount from a position substantially parallel to the first wall to a position substantially perpendicular to the first wall, the stops holding the spring in compression and parallel to the first wall;

20 wherein the spring clamp wraps at least partially around the stem and presses the stem into the primary wall and thereby holds the tube in place.

24. The germicidal lamp for harsh environments of claim 22 wherein the tube comprises a low pressure germicidal tube which, when energized, emits UVC without substantial ozone and can withstand skin effect cooling in an air flow of between 200 cfm and 600 cfm at between 30° F. and 65° F.

25. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 22 wherein the tube emits UVC of at least $10\text{-}\mu\text{W}/\text{cm}^2$ per inch arc length at one meter when an airflow of between 100 and 800 cfm is passed across the tube.

26. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 22 wherein the tube emits UVC of at least $10\text{-}\mu\text{W}/\text{cm}^2$ per inch arc length at one meter when an air flow of between 0° F. and 70° F. is passed across the tube.

27. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 22 having a weight of less than two pounds.

28. The germicidal lamp for harsh environments adapted to be mounted to a wall of claim 22 wherein the lower surface of the base sealing against a wall forms a seal between the fixture and the wall that can withstand air of at least 15 inches of water gage.

29. The germicidal lamp for harsh environments adapted to be mounted to a wall of claim 22, wherein the flange on the stemmed end of the tube sealingly engaging the base when the tube is installed forms a seal between the tube and the fixture that can withstand air pressure of at least 30 inches of water gage.

30. The germicidal lamp for harsh environments adapted to be mounted to a wall of claim 22, wherein the cover sealingly tight to the base forms a seal between the cover and the base that can withstand air pressure of at least 20 inches of water gage.

31. An air handling system comprising the germicidal lamp of claim 22.

32. An HVAC system comprising the germicidal lamp of claim 22.